

Establishing Conservation Easements on Forested Riparian Buffers: Opportunities for Long-term Streamside Protection

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Abstract Forest riparian buffers are an important means of conserving land. The Conservation Reserve Enhancement Program (CREP) offers financial incentives to landowners to install forested riparian buffers under 10–15 year contracts. This study explores whether Pennsylvania CREP participants who had established a riparian buffer would also place it under a permanent conservation easement. A mail questionnaire was developed and administered to 685 CREP participants. It was found that the majority of the respondents are likely to leave their buffer intact when the CREP contract expires, but are hesitant to agree to conservation easements. Property rights, education and finances are among the key issues affecting acceptance of conservation easements.

Keywords Conservation reserve enhancement program (CREP) · Private landowner attitudes · Financial incentives · Water quality

Introduction

Forested riparian buffers play a critical role in the movement and quality of water in watersheds. A buffer is an area designed to protect surface water quality by intercepting water flow and removing nutrients, sediments, organic matter, pesticides and other pollutants prior to entry into surface waters (Welsh 1991). Buffers also provide significant social and environmental benefits, including

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enhanced scenery, recreation, wildlife habitat and carbon sequestration, and water resource protection. In the USA agriculture has played a major role in the disappearance of these riparian habitats. As intensive agricultural land-use practices spread, riparian zones have vanished because they were converted to row crop or pasture land (Zaimes et al. 2004).

Many other countries have also recognized the role and importance of forested riparian buffers in controlling agricultural and timber harvesting erosion problems (Quereshi and Harrison 2003; Oelbermann et al. 2008). For example, Norris 1993 reviewed the role of buffers in controlling water pollution in Australia. He explained their benefits but also cited a lack of information about the most effective ways to establish buffers. Langer et al. (2008) reviewed riparian buffers in New Zealand and showed the benefits in controlling sediment runoff after timber harvesting. In Finnish studies on peatland converted to forest plantations, buffers were found effective but effectiveness was strongly correlated to their width (Nieminen et al. 2005). In recent years, installing and maintaining riparian forest buffers has become a priority of many conservation groups and government agencies. However, in some water-scarce countries, including South Africa, forested buffers are not allowed because research has shown the trees absorb water, reducing downstream flow (Jacobson 2003). Most research is on the environmental benefits, and little is published on the institutional arrangements, payments and subsidies for establishing riparian buffers.

The Chesapeake Bay, the largest estuary in North America, is a prime example of how buffer removal watershed-wide can negatively affect a sensitive aquatic system. Prior to European colonist arrival, the entire Chesapeake Bay watershed was forested. It is estimated that 60% of the watershed's riparian forests have disappeared or are severely impaired (Palone and Todd 1997). Due primarily to agricultural and other non-point source pollutants, the Chesapeake Bay has excessive nutrients that cause algal blooms adversely affecting aquatic biota and water quality. Declining ecological conditions in Chesapeake Bay prompted pressure for states in the Chesapeake Bay watershed to adopt a goal of 10,000 miles (16,000 km) of riparian forested area by 2010 (Chesapeake Bay Program 2005).

More than one-third of the Chesapeake Bay watershed lies within Pennsylvania, and about half of the state's streams and rivers flow into the bay. Pennsylvania has more than 133,000 km of streams and rivers and about one-fifth of these are considered impaired (PA DEP 2005). The implementation of conservation practices, especially riparian buffers, is essential for preventing an increase in stream damage. In most cases, adopting conservation methods including buffers is cost-effective in the long run, but many landowners are concerned about the short-term costs and benefits. Many farmers cannot afford installation of buffers because of their high initial establishment and maintenance costs (Daniels 1988). The US Conservation Reserve Enhancement Program (CREP) is a government-funded program that provides financial incentives to landowners to implement conservation efforts and best management practice on agricultural land.

An option for maintaining the buffers in perpetuity is to create conservation easements. A conservation easement is a negotiated legally binding land protection tool in which the landowner negotiates the development rights to the property, with

the party holding the easement. The landowner retains ownership and gains some tax benefits as well as the knowledge that his or her conservation goals are legally secure (Elfring 1989). A landowner voluntarily donates or sells an interest in their property (the easement value) to a land trust or government agency. Easements remain in private ownership, but the owners permanently relinquish some agreed-upon rights, including development (Goldstein 2002, Merenlender et al. 2004). The voluntary nature, tax incentives, and the knowledge that their land will never be developed are major attractions for landowners prompting them to agree to a conservation easement.

Conservation easements are extremely popular and one of the leading land conservation and preservation tools used in the USA today (Gustanski and Squires 2000; Mortimer et al. 2007). This study explored what Pennsylvania landowners intend to do with the CREP riparian forest buffer when the contract expires, and the likelihood of establishing a permanent conservation easement restricting conversion of their forested buffer.

Study Location and Research Method

Pennsylvania began installing CREP forested riparian buffers on the major tributaries to Chesapeake Bay in 1999. The initial focus in was geared towards the lower 20 counties in the Chesapeake Bay watershed (south-eastern and south-central Pennsylvania) which are surveyed in this paper (Fig. 1). Buffers in the program include trees and shrubs planted in the riparian area with a minimum width of 10 m and a maximum of 55 m. These plantings protect permanent and seasonal streams under 10 to 15 year contracts.

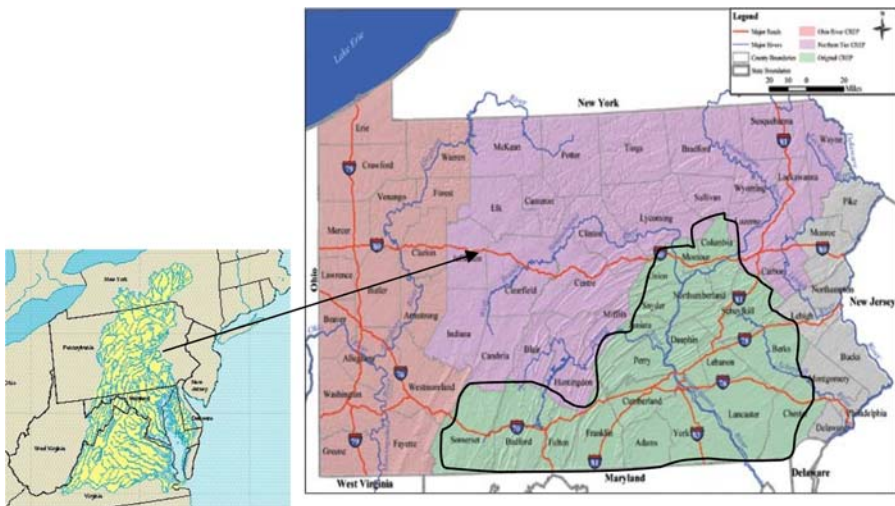


Fig. 1 Map of the Chesapeake Bay watershed (left) and the location of the 20 Pennsylvania CREP forested riparian buffer counties included in the study

CREP pays for buffer installation and provides annual land rental payments until the contract expires. At the end of the contract, landowners can choose to retain, modify or remove buffers. Not surprisingly, policy-makers, conservationists and rural residents have concerns about the fate of land conserved through cost-share programs (Jolly et al. 1995). The Pennsylvania Department of Environmental Protection (PA DEP) and the Chesapeake Bay Foundation (CBF) are interested to determine how and whether these buffers will be maintained in the long run.

The survey questionnaire was developed following the Tailored Design Method of Dillman (2000). To reach participants within a large area on a small budget, Dillman encouraged use of a mail questionnaire for surveys designed to collect descriptive and comparative data. The final questionnaire used in this study drew from existing literature, past studies, and suggestions received from various stakeholders including the Chesapeake Bay Program and CREP managers. The questionnaire evolved through several drafts critiqued by colleagues, advisors, and agencies dealing with both CREP and conservation easements (i.e., PA DEP, Chesapeake Bay Foundation and local conservation districts). The final draft was tested with ten landowners to check whether they understood the questions.

At the time of the study, no Pennsylvania CREP contracts had expired, so landowners were asked about their intention relative to their buffer's future. Central to the study was learning of landowners' intent for their CREP buffer when their contract expires and specifically whether they are interested in a permanent conservation easement for the buffer. Several questions asked about their knowledge of and thoughts about conservation easements. A definition of conservation easements was provided prior to answering specific questions about conservation easements. For the purpose of the survey, a conservation easement was described as a legal agreement between a property owner and a government entity or land trust that permanently restricts a property's uses to protect its conservation values. Conservation values include many of the non-market and public good attributes, including water quality, wildlife, biodiversity and aesthetics.

Descriptive statistics including frequencies and percentages were used to describe mail survey respondent characteristics, and chi-squared tests of independence were used to identify bivariate relationships between variables. A logistic regression model was used to predict odds ratios for variables that were significantly related to a landowner's intent to establish a conservation easement on their CREP forested riparian buffer. The demographic characteristics, land characteristics and the eight factors created from a factor analysis reduction were entered into the logistic regression analysis. Four alternative models were estimated to compare all possible combinations of the dependent variable (Would they establish a conservation easement, No, Maybe, and Yes?). A significance level of 5% was adopted.

Survey Findings

In 2005, a printed questionnaire was mailed to 685 landowners who enrolled their land under the CREP Forested Buffer program, and established riparian buffers, in the 20 original CREP counties in Pennsylvania (Fig. 1). In total, 550 useable

Table 1 Pennsylvania CREP forested riparian buffer participants' prior understanding of conservation easements ($n = 532$)

Understanding level	Relative frequency (%)
None	10.6
Little	22.6
Some	55.6
Extensive	11.2

questionnaires were returned, an 80% response rate. The majority of responders were male, and the average age 58 years. About one in three had a high school education, 19% completed college (i.e., a tertiary course) and almost 14% held a post-graduate degree. The primary occupation reported was split about evenly between farmer, white-collar worker and retired. The median total household annual income was in the US\$20,000–\$59,999 bracket. Respondents reported that their CREP contracts had been in place between 1 and 5 years, with an average of 2.6 years. About 80% of the respondents owned less than 1,500 m of stream frontage, with the largest reported section being 15,000 m. Nearly 200 landowners (45%) had more than 80% of their stream frontage in the CREP buffer program. Most frequently listed reasons for installing a buffer were to improve water quality, express environmental stewardship, receive an incentive payment, and improve non-game wildlife habitat. Respondents reported increases in the occurrence of wildlife, birds and freshwater fish species since the buffer was installed. However, the presence of invasive weeds also increased slightly. Although production from the land decreased slightly, on average there was a minor increase in property income most likely due to CREP incentive payments.

Table 1 reports respondents' knowledge of easements prior to the survey. Almost 90% of the respondents indicated they knew what a conservation easement is, and about 11% of those said that their knowledge is extensive. Seventy percent of the landowners indicated they are very likely to leave the buffer intact when the contract expires. Only 12 individuals (2%) said they were very likely to remove the buffer (Table 2).

About 18% of respondents said they would consider establishing a conservation easement on their CREP forested riparian buffer, 27% replied that they were not interested, and the remaining 55% indicated they may be interested but need more information. Relatively few respondents (15%) said they had an existing conservation easement on their property.

The main concerns with a conservation easement were giving up particular rights to their land and allowing public access. Working with the easement agency, paying for the surveying, and deed recording costs were issues of least concern. When asked about the benefits of conservation easements, landowners said that water quality improvement, wildlife habitat preservation, and long-term riparian habitat protection were most important.

Several demographic characteristics were significant in explaining landowner reasons for a conservation easement on their riparian buffer (Table 2). Landowners who expressed interest in establishing a conservation easement tended to be middle

Table 2 Socio-demographics of Pennsylvania CREP participants and willingness to establish conservation easements on CREP-funded forested riparian buffers

Characteristic	Relative frequency (%)			χ^2
	No	Yes	Maybe	
Gender (<i>n</i> = 472)				.034
Male	28	18	54	
Female	27	19	54	
Age (<i>n</i> = 468)				11.139*
65 years or older	39	12	49	
45–64 years	24	21	55	
Less the 45 years	23	16	61	
Education (<i>n</i> = 472)				20.547**
High school diploma or less	32	10	58	
Some college credits or diploma	22	22	56	
Some post-graduate degree or credits	26	29	45	
Occupation (<i>n</i> = 444)				29.846**
Farmer	37	19	44	
Retired	31	17	52	
White-collar	23	32	45	
Blue-collar/other	23	8	69	
Annual household income (<i>n</i> = 405)				15.555*
Less then \$20,000	24	4	72	
\$20,000 to \$59,999	31	15	54	
\$60,000 to \$99,999	17	24	59	
\$100,000 or more	32	23	45	

** $P < 0.01$, * $P < 0.05$

aged, have more education, classify themselves as white collar or retired and have mid-range incomes.

There was a significant relationship between the landowner's willingness to establish a riparian conservation easement and their understanding of conservation easements (Table 3). There was no significant relationship between establishing an easement and ownership size or the size of the CREP buffer, but those who have a buffer of less than 4 ha were more likely to leave the buffer intact after the contract expires.

Logistic regression was used to determine what specific factors and characteristics were significant in landowner willingness to establish riparian conservation easements. Four separate models were developed to test response combinations of No, Maybe and Yes (all possible answers to the dependent variable, namely willingness to establish a conservation easement on CREP riparian buffers). Each model was fitted and then re-estimated to include only those variables which proved to be significant in the original model. Only the reduced models are reported. Independent variables used in each model are listed in Table 4.

Table 3 CREP participants knowledge of conservation easements and willingness to establish easements on forested riparian buffers ($n = 478$)

Knowledge of easements	Relative frequency (%)			χ^2
	No	Yes	Maybe	
None	22	13	65	46.286**
Little	26	8	66	
Some	32	17	51	
Extensive	15	47	38	

** Significant at the 1% level

Table 4 Variables included in all four logistic regression models

Characteristic type and variable	Factor analysis components
Landowner characteristics	Agricultural preservation
Age	Financial issues of landowner
Education	Environmental stewardship
Conservation easement knowledge	Land concerns
Availability of conservation education	Financial concerns
Parcel characteristics	Environmental benefits
Established conservation easement	Financial benefits

The results of the logistic regression are expressed as odds ratios (e^b). The first model—landowners answering either No or Yes (Table 5)—indicates that those landowners who are more likely to say Yes than No are more highly educated, already have an established conservation easement, and recognize the potential environmental benefits of conservation easements. CREP landowners who say they currently have an established conservation easement on their property are almost 12 times as likely to say Yes than landowners who do not have an easement. Landowners who are more educated also recognize the environmental benefits of easement establishment and are almost twice as likely to answer Yes.

The second model—landowners answering No or Maybe (Table 6)—revealed that a strong understanding of the potential benefits of conservation easement makes a landowner twice as likely to choose Maybe over No. However, this model also suggests that with an increase in conservation easement knowledge, landowners are about 1.7 times as likely to choose No over Maybe. This suggests that conservation easement understanding could lead landowners away from easement establishment on their property even though they believe there are conservation benefits from easements. This could in part be explained by a bias against government programs due to fears over government control of their land use decisions and loss of future financial options from the land.

Table 5 Reduced model 1—logistic regression for PA CREP landowners answering no or yes to establishing conservation easements on CREP forested riparian buffers

Category of variable	Model coefficient	Odds ratio
Landowner characteristics		
Education	0.548**	1.730
Parcel characteristics		
Established conservation easement	2.478**	11.919
Factor analysis components		
Environmental benefits	0.628*	1.874

** $P < 0.01$, * $P < 0.05$, model $\chi^2 = 49.464$, $df = 3$

Table 6 Reduced model 2—logistic regression for PA CREP landowners answering no or maybe to establishing conservation easements on CREP forested riparian buffers

Category of variable	Model coefficient	Odds ratio
Landowner characteristics		
Conservation easement knowledge	−0.406**	0.666
Factor analysis components		
Environmental benefits	0.663**	1.884

** $P < 0.01$, * $P < 0.05$, model $\chi^2 = 19.477$, $df = 2$

The third model (landowners answering Yes or Maybe) has four significant variables (Table 7). Landowners with greater education are 1.5 times as likely to answer Yes as against Maybe or No? Landowners who perceive their easement knowledge to be strong are almost twice as likely to answer Yes over Maybe. If an established conservation easement is present on the land, the landowner is 3.5 times as likely to establish a new easement. Financial issues have a significant negative influence on the landowner's decision. Landowners who indicated financial reasons for their enrollment in CREP are twice as likely to choose Maybe over Yes.

As indicated in Table 8, the same relationships seen in Model 3 are present in Model 4 (landowners answering Yes or No/Maybe). More educated landowners are 1.5 times as likely to establish an easement as those with little or no formal education. Landowners who perceive their knowledge of conservation easements to be high are almost twice as likely to answer Yes. Financial reasons for CREP enrollment prove again to be significant. Those who indicated financial reasons for enrollment are 70% more likely to choose No or Maybe than Yes to establishing a conservation easement.

Discussion

Pennsylvania CREP participants are concerned about conservation of natural resources. About 75% of the survey participants felt that protecting natural resources and expressing environmental stewardship are important to them as farmers and landowners. They acknowledge that land preservation and tax

Table 7 Reduced model 3—logistic regression for PA CREP landowners answering yes or maybe to establishing conservation easements on CREP forested riparian buffers

Category of variable	Model coefficient	Odds ratio
Landowner characteristics		
Education	0.345**	1.412
Conservation easement knowledge	0.692**	1.997
Parcel characteristics		
Established conservation easement	1.261**	3.530
Factor analysis components		
Financial issues	−0.373*	0.689

** $P < 0.01$, * $P < 0.05$, model $\chi^2 = 53.159$, $df = 4$

Table 8 Reduced model for all four logistic regressions for PA CREP landowners answering yes or no/maybe to establishing conservation easements on CREP forested riparian buffers

Category of variable	Model coefficient	Odds ratio
Landowner characteristics		
Education	0.339**	1.404
Conservation easement knowledge	0.681**	1.976
Parcel characteristics		
Established conservation easement	1.375**	3.954
Factor analysis components		
Financial issues	−0.356*	0.701

** $P < 0.01$, * $P < 0.05$, model $\chi^2 = 61.4$, $df = 4$

incentives are important reasons for developing a conservation easement, but nevertheless were also cautious when committing to one. Fortunately, landowners say the buffers they installed through CREP will remain intact into the foreseeable future. This does not allay the concern of conservation groups and government agencies. The concern is more acute when prices of crops previously grown in the buffer zones including maize and soybeans are very high, as has been the case in recent times, in part due to their growing use in biofuels (Worldwatch Institute 2007). This shows how important external factors such as food prices are in landowners making these land-use decisions.

A synthesis of results from the four logit models indicates that education, conservation easement knowledge, existing conservation easements, environmental benefits and financial considerations all affect landowner's decisions. Landowners who are more willing to establish easements and identify with the environmental benefits of easements are more educated and perceive that they have a stronger conservation easement knowledge than those who state a negative opinion or are unsure of easement establishment. However, landowners who perhaps are concerned about environmental issues but more concerned about financial issues are less likely to consider an easement. This suggests that in order to get the

'Maybe' respondents to accept an easement, incentive payments, tax reductions or both are needed. There are also income opportunities from buffers in timber products when they mature and shorter term revenues from non-timber forest products (e.g., from sale of ginseng, fruits or nuts). This requires education in terms of tradeoffs and benefits in cultivating alternative income opportunities from the buffers.

The size of the CREP riparian buffer bears no relationship to the landowner's willingness to establish a conservation easement, but it does bear a significant relationship to the landowner's future intentions. Larger landowners, more likely involved in intensive crop or livestock production, are less clear about whether their buffer will remain forested. These landowners might consider removing the trees after the CREP contract expires. Certainly, rising farm commodity prices may influence their decisions to remove the buffer. Landowners with smaller properties are likely part-time farmers or woodlot owners and rely more on other income sources and are therefore more likely leave the buffers. Although the impact on water quality and other buffer benefits are seen in the small plots, the larger tracts are critically important in the overall restoration of streams and rivers. If cost share programs similar to CREP are introduced, their payments should be comparable to the financial returns from maize and soybeans, which have continually been on the rise in recent years.

Currently, Pennsylvania has no easement program associated with CREP. However, some respondents interestingly described their CREP buffer as a conservation easement. Possibly these landowners misunderstood what conservation easements are, although a definition was provided in the questionnaire. About one-quarter of respondents indicated that they have a conservation easement on their property but did not describe the easement. These results suggest many landowners lack a real comprehension of conservation easements even when they consider themselves knowledgeable on the topic. The logistic regression analyses indicate that education and easement understanding affect landowner decisions about conservation easement establishment. This is especially likely in the case of landowners who did not respond. More knowledge about easements is positively correlated with a greater willingness to establish an easement. Those who have no understanding of conservation easements were most likely to answer Maybe and least likely to answer Yes to establishing an easement on their buffer.

In addition to more education on economic benefits from buffers and the role of easements, an indication of the need for education is that the respondents overestimated the size of forested riparian buffers. The average size reported was 4 ha, while the PA DEP says the average size is 2.5 ha. Clearly, landowners overestimated their buffer acreage by a substantial amount, which supports a conclusion that owners do not have a clear grasp on the details of their CREP buffer and the CREP program. This may be partly because CREP paid outside contractors to install the buffer so it is not clear how involved landowners were in the process. Landowners not truly interested in their land would not care or desire to know the fine details of the agreement, including size of buffer planting. In many situations, after the CREP planting, landowners never really thought about their buffer planting except when they received their annual rental payment.

An earlier study of Pennsylvania landowners (Hansel 2002) found, as have numerous studies across the country, that landowners shy away from conservation programs such as conservation easements because they place great value on their private property rights. This is one reason why so few landowners would automatically consider a conservation easement on their CREP riparian buffer. Another reason revealed by logistic regression Model 2 is that even those with a sound knowledge of easements who said ‘Maybe’ are less likely to establish one, probably due to a fear of weakened property rights. However, conservation easements do clearly allow landowners to maintain private land ownership rights. This is another important topic about easements for which education is needed.

Several studies have found that economic considerations are a primary factor when making decisions about establishing and continuing conservation practices (Osborne and Heimlich 1993; Maynard et al. 1998, Rilla 2002). This relationship was also observed in this study. Financial considerations proved significant in two of the regression models suggesting that those concerned about agricultural finances are less likely to establish easements on CREP buffers. The models reveal that concern for the environment is important for landowners who chose Yes or No to easement establishment, but finances are a greater influence for those unsure about easement establishment. About two-thirds of the participants’ forested stream frontage resulted from CREP incentive support and many landowners reported that the incentive payment and signing bonus were influential in their decision to enroll in CREP. However, concern for natural resources and land preservation were of higher importance to the landowners who reported that financial issues were important when considering establishment of a conservation easement.

Landowners recognize and pursue financial benefits as a reason for enrollment in conservation programs, but are unsure of the financial benefits a conservation easement can provide. This also explains a landowner’s reluctance to consider a conservation easement on their land. Another educational program area to focus on is the tax benefits from a conservation easement. This may sway those ‘Maybe’ respondents in favour of an easement if they know all the benefits of foregoing development rights to a conservation easement, including tax incentives and other potential economic returns such as non-timber forest products. Overall, CREP forested riparian buffer participants in Pennsylvania are satisfied with the amount of money received in exchange for establishing their riparian buffer. Even though the buffer has removed land from production, there was an increase in income, probably due to the rental payment. It will be interesting to follow-up once the buffers are mature by re-surveying landowner’s attitudes and the quality of the buffers.

The question remains: what will happen when the payments cease? Fortunately, the agencies involved have an opportunity, based on the results of the survey, to implement specific educational objectives prior to the expiration of the contracts. Education is the best tool for convincing landowners to establish permanent conservation easements on their CREP buffers. Landowners need to know what benefits conservation easements provide, to themselves and wider community. The financial and environmental benefits are often misunderstood or unknown to property owners.

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